Improving Imaging Methods for Breast Cancer Detection and Diagnosis

The National Cancer Institute (NCI) is supporting numerous research projects to improve conventional mammography and develop alternative imaging technologies to detect and characterize breast tumors.

For breast cancer screening, high-quality mammography (an x-ray technique to visualize the internal structure of the breast) is the most effective technology presently available. Efforts to improve conventional mammography center on refinements of the technology and quality assurance in the administration and interpretation of the x-ray films. To advance breast imaging, NCI is funding research to reduce the already low radiation dosage; enhance image quality; develop and evaluate digital mammography as an improvement over the conventional, film-based technique; develop statistical techniques for computer-assisted interpretation of digitized images; and enable long-distance image transmission technology (teleradiology) for clinical consultations. NCI also supports research on non-x-ray based technologies such as magnetic resonance imaging (MRI) and breast-specific positron emission tomography (PET) to detect the disease.

Digital Mammography

Digital mammography is a computerized technique that displays images using an infinite scale of gray tones. Mammography x-ray films can contain subtle information not easily discernible to a radiologist. Digital images potentially could enhance the quality of the image and even magnify the view of specific areas of the breast. This technology is expected to improve the sensitivity of mammography, especially in radiographically "dense" breast tissue, which makes visualization of cancer difficult, and to decrease the dose of radiation used per mammogram. Digital mammography also will allow computer-aided diagnosis and teleradiology.

NCI supports many studies using this technology, including those of the National Digital Mammography Development Group. This multidisciplinary academic and industrial group is developing and evaluating digital mammography and related technologies such as image processing for improved lesion visualization, computer-aided diagnosis for enhanced image interpretation, and telemammography (electronic image transmission to specialized clinical experts at remote sites). Currently, this Group is testing the potential of digital mammography to serve as the next generation screening technology.

Novel Nonionizing Radiation (Non-x-Ray) Imaging

Scientists are exploring novel nonionizing imaging technologies including MRI, ultrasound, optical imaging, and other technologies. The NCI-funded studies encompass basic technology and instrumentation development through preclinical and clinical testing. They aim to define the precise role of the technologies in detecting and characterizing breast tumors.

MRI and Ultrasound

Of novel nonionizing technologies, MRI and ultrasound have been the most studied as ways to improve the sensitivity of breast cancer detection and staging. Both have shown potential for improving differentiation between benign and malignant lesions and in detecting tumors in dense breast tissue. Furthermore, MRI appears unique in its ability to define local tumor extent, or staging, which is critical for treatment planning.

MRI and ultrasound have their limitations, too. MRI cannot detect microcalcifications, minute calcium deposits that may indicate a small tumor. About half of cancers detected by mammography appear as a cluster of microcalcifications. Ultrasound does not consistently detect microcalcifications, nor can it detect very small tumors.

Breast Biopsies

Imaging is also being tested as an aid in performing biopsies. The majority of women in the United States (80 percent) who undergo surgical breast biopsies do not have cancer. As an alternative to surgical tissue removal, image-guided, needle breast biopsy is being studied for women with nonpalpable lesions. (Women who have large, palpable lesions usually undergo needle aspirations to determine if their lesions are fluid-filled benign cysts.) Image-guided needle biopsy offers the potential advantages of minimized tissue damage, reduced waiting time until diagnosis, and lower costs. A multi-institutional research program is now testing the efficacy and cost-effectiveness of the large-core and fine-needle biopsies compared with more extensive surgical biopsies.

Other Areas of Study

In addition to research on imaging technologies, other research is under way to develop methods to detect products of breast cancer (antigens) in blood, urine, or nipple aspirates, and to detect genetic alterations in women who are at increased risk for breast cancer. Once cancer is diagnosed, studies of these types contribute to characterization of breast tumors and can be useful in treatment planning. Still other NCI-funded projects seek to increase the utilization of mammography, with special emphasis on increasing utilization among minority and medically underserved women.

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Sources of National Cancer Institute Information

Cancer Information Service

Toll-free: 1–800–4–CANCER (1–800–422–6237)
TTY (for deaf and hard of hearing callers): 1–800–332–8615

NCI Online

Internet

Use http://www.cancer.gov to reach NCI's Web site.

CancerMail Service

To obtain a contents list, send e-mail to cancermail@icicc.nci.nih.gov with the word "help" in the body of the message.

CancerFax® fax on demand service

Dial 301–402–5874 and listen to recorded instructions.

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